

# P03 Planning and Uncertainty

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# 1 $2 \times 2$ Rubik's Cube

Please solve the  $2 \times 2$  Rubik's Cube by using FF planner. Here are 5 cases for you to verify the correctness of your programs (pddl files). You should hand in 6 files, including a domain file (cube\_domain.pddl) and 5 data files (cube1.pddl, cube2.pddl, cube3.pddl, cube4.pddl, cube5.pddl). For more information about  $2 \times 2$  Rubik's Cube, such as actions R, U and F, please refer to <https://rubiks-cube-solver.com/2x2/>.

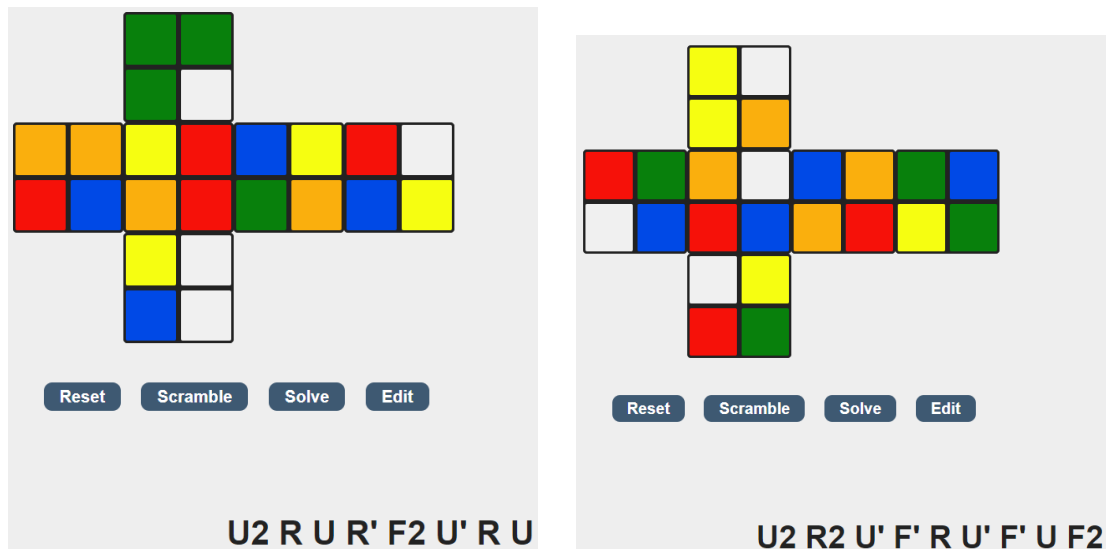


Figure 1:  $2 \times 2$  Rubik's Cube case1 and case2

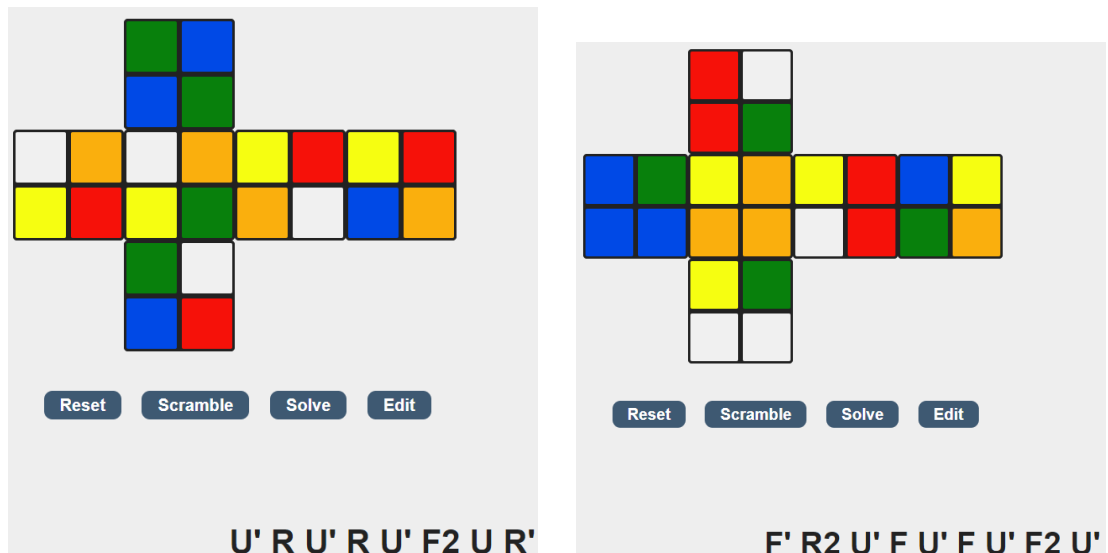


Figure 2:  $2 \times 2$  Rubik's Cube case3 and case4

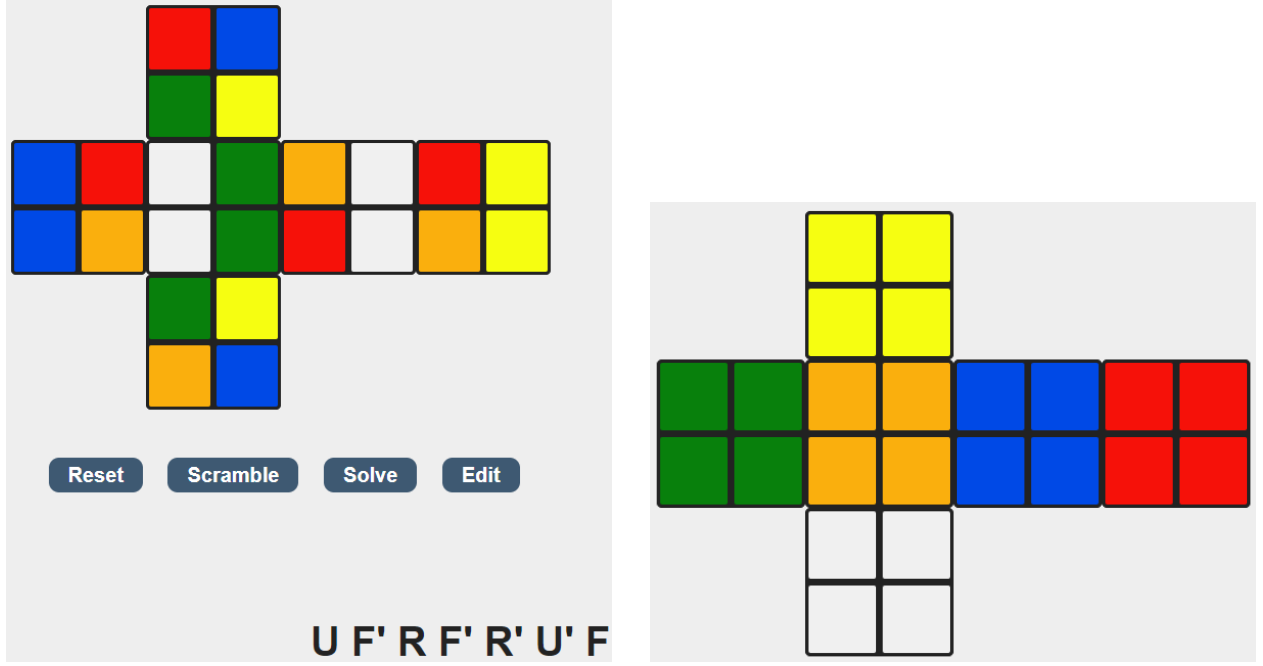


Figure 3:  $2 \times 2$  Rubik's Cube case5 and the goal state

## 2 Diagnosing by Bayesian Networks

### 2.1 Variables and their domains

- (1) PatientAge: ['0-30', '31-65', '65+']
- (2) CTScanResult: ['Ischemic Stroke', 'Hemorrhagic Stroke']
- (3) MRIScanResult: ['Ischemic Stroke', 'Hemorrhagic Stroke']
- (4) StrokeType: ['Ischemic Stroke', 'Hemorrhagic Stroke', 'Stroke Mimic']
- (5) Anticoagulants: ['Used', 'Not used']
- (6) Mortality: ['True', 'False']
- (7) Disability: ['Negligible', 'Moderate', 'Severe']

### 2.2 CPTs

**Note:** [CTScanResult, MRIScanResult, StrokeType] means:

$$P(\text{StrokeType}=\text{'...'} \mid \text{CTScanResult}=\text{'...'} \wedge \text{MRIScanResult}=\text{'...'})$$

(1)

[PatientAge]

['0-30', 0.10],

['31-65', 0.30],

[ '65+', 0.60]

(2)

[CTScanResult]

[ 'Ischemic Stroke ', 0.7],

[ 'Hemorrhagic Stroke ', 0.3]

(3)

[MRIScanResult]

[ 'Ischemic Stroke ', 0.7],

[ 'Hemorrhagic Stroke ', 0.3]

(4)

[Anticoagulants]

[Used ', 0.5],

[ 'Not used ', 0.5]

(5)

[CTScanResult, MRIScanResult, StrokeType])

[ 'Ischemic Stroke ', 'Ischemic Stroke ', 'Ischemic Stroke ', 0.8],

[ 'Ischemic Stroke ', 'Hemorrhagic Stroke ', 'Ischemic Stroke ', 0.5],

[ 'Hemorrhagic Stroke ', 'Ischemic Stroke ', 'Ischemic Stroke ', 0.5],

[ 'Hemorrhagic Stroke ', 'Hemorrhagic Stroke ', 'Ischemic Stroke ', 0],

[ 'Ischemic Stroke ', 'Ischemic Stroke ', 'Hemorrhagic Stroke ', 0],

[ 'Ischemic Stroke ', 'Hemorrhagic Stroke ', 'Hemorrhagic Stroke ', 0.4],

[ 'Hemorrhagic Stroke ', 'Ischemic Stroke ', 'Hemorrhagic Stroke ', 0.4],

[ 'Hemorrhagic Stroke ', 'Hemorrhagic Stroke ', 'Hemorrhagic Stroke ', 0.9],

```
[ 'Ischemic Stroke ', 'Ischemic Stroke ', 'Stroke Mimic ', 0.2 ],
[ 'Ischemic Stroke ', 'Hemorrhagic Stroke ', 'Stroke Mimic ', 0.1 ],
[ 'Hemorrhagic Stroke ', 'Ischemic Stroke ', 'Stroke Mimic ', 0.1 ],
[ 'Hemorrhagic Stroke ', 'Hemorrhagic Stroke ', 'Stroke Mimic ', 0.1 ],
```

(6)

```
[StrokeType, Anticoagulants, Mortality]
```

```
[ 'Ischemic Stroke ', 'Used ', 'False ', 0.28 ],
[ 'Hemorrhagic Stroke ', 'Used ', 'False ', 0.99 ],
[ 'Stroke Mimic ', 'Used ', 'False ', 0.1 ],
[ 'Ischemic Stroke ', 'Not used ', 'False ', 0.56 ],
[ 'Hemorrhagic Stroke ', 'Not used ', 'False ', 0.58 ],
[ 'Stroke Mimic ', 'Not used ', 'False ', 0.05 ],
```

```
[ 'Ischemic Stroke ', 'Used ', 'True ', 0.72 ],
[ 'Hemorrhagic Stroke ', 'Used ', 'True ', 0.01 ],
[ 'Stroke Mimic ', 'Used ', 'True ', 0.9 ],
[ 'Ischemic Stroke ', 'Not used ', 'True ', 0.44 ],
[ 'Hemorrhagic Stroke ', 'Not used ', 'True ', 0.42 ],
[ 'Stroke Mimic ', 'Not used ', 'True ', 0.95 ]
```

(7)

```
[StrokeType, PatientAge, Disability]
```

```
[ 'Ischemic Stroke ', '0-30 ', 'Negligible ', 0.80 ],
[ 'Hemorrhagic Stroke ', '0-30 ', 'Negligible ', 0.70 ],
[ 'Stroke Mimic ', '0-30 ', 'Negligible ', 0.9 ],
[ 'Ischemic Stroke ', '31-65 ', 'Negligible ', 0.60 ],
[ 'Hemorrhagic Stroke ', '31-65 ', 'Negligible ', 0.50 ],
[ 'Stroke Mimic ', '31-65 ', 'Negligible ', 0.4 ],
[ 'Ischemic Stroke ', '65+ ', 'Negligible ', 0.30 ],
[ 'Hemorrhagic Stroke ', '65+ ', 'Negligible ', 0.20 ],
```

[ 'Stroke Mimic' , '65+' , 'Negligible' , 0.1 ] ,

[ 'Ischemic Stroke' , '0-30' , 'Moderate' , 0.1 ] ,

[ 'Hemorrhagic Stroke' , '0-30' , 'Moderate' , 0.2 ] ,

[ 'Stroke Mimic' , '0-30' , 'Moderate' , 0.05 ] ,

[ 'Ischemic Stroke' , '31-65' , 'Moderate' , 0.3 ] ,

[ 'Hemorrhagic Stroke' , '31-65' , 'Moderate' , 0.4 ] ,

[ 'Stroke Mimic' , '31-65' , 'Moderate' , 0.3 ] ,

[ 'Ischemic Stroke' , '65+' , 'Moderate' , 0.4 ] ,

[ 'Hemorrhagic Stroke' , '65+' , 'Moderate' , 0.2 ] ,

[ 'Stroke Mimic' , '65+' , 'Moderate' , 0.1 ] ,

[ 'Ischemic Stroke' , '0-30' , 'Severe' , 0.1 ] ,

[ 'Hemorrhagic Stroke' , '0-30' , 'Severe' , 0.1 ] ,

[ 'Stroke Mimic' , '0-30' , 'Severe' , 0.05 ] ,

[ 'Ischemic Stroke' , '31-65' , 'Severe' , 0.1 ] ,

[ 'Hemorrhagic Stroke' , '31-65' , 'Severe' , 0.1 ] ,

[ 'Stroke Mimic' , '31-65' , 'Severe' , 0.3 ] ,

[ 'Ischemic Stroke' , '65+' , 'Severe' , 0.3 ] ,

[ 'Hemorrhagic Stroke' , '65+' , 'Severe' , 0.6 ] ,

[ 'Stroke Mimic' , '65+' , 'Severe' , 0.8 ]

## 2.3 Calculation

Please implement the **VE algorithm** (C++ or Python) to calculate the following probability value:

$p1 = P(\text{Mortality} = \text{'True'} \wedge \text{CTScanResult} = \text{'Ischemic Stroke'} \mid \text{PatientAge} = \text{'31-65'})$

$p2 = P(\text{Disability} = \text{'Moderate'} \wedge \text{CTScanResult} = \text{'Hemorrhagic Stroke'} \mid \text{PatientAge} = \text{'65+'} \wedge \text{MRIScanResult} = \text{'Hemorrhagic Stroke'})$

$p3 = P(\text{StrokeType} = \text{'Hemorrhagic Stroke'} \mid \text{PatientAge} = \text{'65+'} \wedge \text{CTScanResult} = \text{'Hemorrhagic Stroke'} \wedge \text{MRIScanResult} = \text{'Ischemic Stroke'})$

$p4 = P(\text{Anticoagulants} = \text{'Used'} \mid \text{PatientAge} = \text{'31-65'})$

$p5 = P(\text{Disability} = \text{'Negligible'})$

### 3 Notes

1. For task1, I will grade your codes in correctness of 5cases, the number of steps, and time cost.
2. For task2, I will grade your codes in VE implementation, correctness of 5 cases and algorithm efficiency.
3. Please send **P03\_Number1\_Number2.zip** which should contain the codes and results of the above two problems to the mailbox (**ai\_2018@foxmail.com**) before the deadline (**2018/11/18 23:59**).
4. Last but not least, you are not alone! If you find yourself stuck on something, contact the TA (QQ: 24747380) for help.